

A
PROBATIONARY
SURGICAL ESSAY

ON
A N E U R I S M :

SUBMITTED,

BY AUTHORITY OF THE PRESIDENT AND HIS
COUNCIL,

TO THE EXAMINATION OF THE

Royal College of Surgeons of Edinburgh,

WHEN CANDIDATE

FOR ADMISSION INTO THEIR CORPORATION,

IN CONFORMITY

TO THEIR REGULATIONS RESPECTING THE ADMISSION

OF

ORDINARY MEMBERS.

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OF EDINBURGH.

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TO

JAMES LAW, Esq.

OF ELVINGSTON,

PRESIDENT OF THE ROYAL COLLEGE OF SURGEONS

OF EDINBURGH,

&c. &c. &c.

AS A SMALL MARK OF THE RESPECT AND ESTEEM

OF

HIS GRATEFUL FRIEND,

JOHN FYFE.

ESSAY

ON

A NEURISM.

IN the following Essay, I do not intend to describe the Aneurisms of particular arteries, but only to offer a few observations on Aneurism in general.

The more fully to illustrate the pathology of this disease, it will be necessary to say a few words on the anatomical structure of arteries.

Structure of Arteries.

ARTERIES are composed of three coats, viz. an external or Cellular, middle or Muscular,

and internal or Serous coat; each differing in their nature, and each of them possessing their own peculiar office. The external or cellular coat is a solid condensed layer of cellular substance, which is of a very elastic nature; it is rough and unequal on its outer surface, but smooth internally, where it is joined with the muscular coat. The external surface of this coat is generally slightly connected with another loose layer of cellular substance, which, in most parts of the body, but more especially in the extremities, may be said to form a fourth coat; however, this often affords a common covering both to arteries and veins. This cellular sheath deserves attention, as it is concerned in the suppression of hæmorrhage, and also in the formation of the diffuse species of Aneurism. The elasticity of the cellular coat is in some degree an antagonist to the power of the muscular one; and it is chiefly owing to the elasticity of this coat, that an artery, when cut across, shrinks up within its outer sheath, thus

proving the first check to the progress of hæmorrhage.

Within this cellular coat, there are one or two strata of muscular fibres which encircle the artery, but so formed, that no single fibre completely surrounds it, two or three of these segments being commonly requisite to complete the circle. These fibres are commonly more apparent in arteries of a medium size, than in the aorta; these strata are connected together by intervening cellular substance; each circle is also conjoined to its fellow by means of the same substance. No muscular fibres can be traced running in a longitudinal direction; this coat is therefore very weak, and is easily lacerated transversely; these fibres can of course only act in a transverse direction, and their power of contraction seems to increase the farther the artery recedes from the heart*.

* Hunter on the Blood.

The innermost coat of the artery, though very thin, is nevertheless a strong dense membrane, very smooth internally, possessing properties analogous to the membranes of the serous class; hence it has been called the Serous Coat. It is this internal coat which is the chief cause of retaining the blood within the artery.

To guard as much as possible against the obliteration or destruction of any part of the main trunk of an artery, proving detrimental to the life of the part beyond it, nature has caused a free communication, or anastomoses, to take place between the vessels of different parts of the body. These anastomoses happen betwixt the main trunks, in some of the viscera; but in the extremities, they only exist between the smaller ramifications, and are observed more remarkably around the great joints, than in other parts of the limbs. These anastomosing branches can sometimes be filled, in the healthy

subject, with the coarse injection used by anatomists ; but in those cases, where the passage of the blood through the artery has, from any cause, been either retarded or obstructed, they become greatly enlarged, and perfectly adequate to supply a sufficient quantity of blood for the life and nourishment of the limb, beyond the part where the obstruction exists. Surgeons do not now hesitate to apply a ligature round the external iliac artery ; in which case, the whole leg must afterwards be supplied with blood from those branches of the internal iliac which communicate with the branches of the profunda femoris. Hence it appears, that a great portion of the body may be nourished by those anastomosing branches, which were formerly almost entirely disregarded.

Arteries, like other parts of the body, are liable to inflammation ; but when they are wounded, the edges of that wound very seldom adhere, so as to leave the tube of the vessel

pervious. This, however, does sometimes happen, especially in wounds of the humeral artery at the bend of the arm, after the operation of blood-letting. But so very rarely is a radical cure obtained in this way, that even Scarpa, notwithstanding his extensive knowledge of diseases of the arterial system, only knew of one instance. It would appear, however, from some of Mr Jones's experiments, that this adhesion of the wounded sides of an artery takes place more frequently than Scarpa supposes. But if the opposite sides of a wounded artery be kept for some length of time in mutual contact, the adhesive inflammation soon agglutinates them together, and converts the artery into a solid ligamentous cord, for a little way both above and below the place where the pressure was applied. If the artery has been compressed by means of a ligature, the ulcerative inflammation immediately ensues after the adhesive, and proceeds, until the cord which

was formerly the artery be completely divided, after which the ligature comes away.

This adhesion will often take place in arteries, when their opposite sides are merely kept in contact by means of proper pressure ; but it is much more certainly and more speedily induced by the application of a tight ligature around the vessel, which seems to be owing to the division of the two inner coats of the artery* ; for an effusion of coagulable lymph, and speedy induction of the adhesive inflammation, are the consequences of the division of these coats. This effusion of lymph, and consequent adhesion, so invariably result from the cutting of these coats, that the momentary application of a ligature, so as to affect this division, is, in some cases, especially of the smaller arteries, sufficient to complete the union of the opposite sides of the vessel.

* Jones on Hæmorrhage.

PATHOLOGY OF THE DISEASE.

THE internal coat of arteries is subject, more particularly in elderly people, to a change of its structure, and to a deposition of earthy, or rather osseous matter; which disease Scarpa calls a “ *slow, morbid, ulcerated, steatomatous, fungous, squamous degeneration of the internal coat**.” No artery is exempt from this diseased state of its inner coat; but it more frequently happens at the curvature of the aorta than elsewhere. In the incipient stage of this disease, which lays the foundation for future aneurisms, the inner coat of the artery loses its beautiful smoothness, and becomes irregular and wrinkled. It afterwards appears beset with yellow spots, which soon become converted into “ *steatomatous and cheese-like*

* Scarpa on Aneurism, translated by Wishart.

“ concretions *.” Osseous matter is then deposited, which renders the part so extremely brittle, that it separates in scales, by the application of the slightest force. In many cases, when this disease exists, the diameter of the artery becomes lessened at the diseased part.

This change of structure diminishes the cohesion betwixt the different coats of the artery, and renders the internal one so very delicate, that it often happens from over-exertion, but more frequently, perhaps, from an erosion of the diseased parts of the internal coat, that the blood oozes through it; and from the very slender resistance which the muscular one affords, it very soon makes its way through this coat by separating the fibres from one another. The blood then comes in contact with the external cellular coat, which, yielding to the pres-

* Scarpa.

sure from within, is slowly diffused under it. Every stroke of the heart now propels more and more blood through this aperture in the two inner coats, which gradually becomes larger, and the cellular coat, yielding to the force of the blood, is by degrees formed into a tumor, which daily increases in size. At the same time that the inner coats are affected with this disease, the external one becomes thicker, and forms stronger adhesions around the diseased spot, and thus forms a barrier to the blood when it is effused.

Mr Burns, speaking of this circumstance, says, “ They are in every respect new-formed
“ parts, though they occupy the place of the
“ former coats of the artery ; and we have, in
“ our dissections, uniformly found the inner
“ surface of the cellular coat crusted over with
“ lymphatic glazing, and that whether the tu-
“ mor was small or large.

“ If the cellular coat of the vessel, at the
“ time the rupture of the internal tunics of the
“ artery takes place, be not thickened and rendered firmer than usual, it would be incapable of retaining the blood *.”

The phenomena above related may be exhibited artificially on the dead subject, and the experiment has been frequently repeated with success by Mr Nichols †, by forcibly pushing some fluid into the artery, which, as soon as it ruptures the inner coats, becomes effused under the external cellular coat, and raises it up in the form of an aneurismal tumor, thus exhibiting the same appearances which actually occur in Aneurism.

The aneurismal sac never comprehends the whole circumference of the vessel, and that

* Burns on Diseases of the Heart.

† Phil. Transac.

part of the tumor which immediately arises from the artery is generally constricted, becoming gradually larger as it recedes; which appearances could never happen, did Aneurism arise from a dilatation of all the coats of the artery.

If the artery be now opened longitudinally, on the side opposite to that where the rupture has taken place, the coats, by a little care, can be separated from one another; osseous or earthy parts will frequently be found in this part of the vessel, and the rupture, with its fringed or callous edges, leading into the aneurismal tumor, will be seen on the opposite side of the artery.

The coats of the artery at this part are very thin, and generally much diseased; and it is with difficulty that we can separate the internal coat from the muscular one, as they are so

much disorganized all around the fissure which leads into the aneurismal sac.

If the tumor be opened, and the clotted blood carefully washed out, the cellular coat may, with a little attention, be traced from that part of the artery where the tumor commences, and the tube of the vessel will be found lying at the bottom of the sac, but deprived of its external coat.

That this is the true state of parts in Aneurism, (viz. a rupture of the two inner coats of the artery, and consequent effusion of blood under the cellular one), is now established, I believe, to a certainty; and the division of Aneurisms into true and false now almost completely exploded.

The coats of arteries certainly do sometimes take on such a diseased state, that they become thickened and dilated. Scarpa himself allows

that the dilatation sometimes exists at the mouth of the aorta. But this, as he justly observes, is a different disease from Aneurism. In the simple enlargement or dilatation of an artery, we never find any coagulated blood; so, of course, there can be no impediment to the circulation through this dilated artery, and when this dilatation exists, it very seldom attains any considerable size; this diseased state of the artery is most frequently found at the arch of the aorta.

I have seen both diseases distinctly illustrated in the same preparation, where an Aneurism of the *arteria innominata* was accompanied with a considerable dilatation of the aorta. Indeed, in most cases of thoracic Aneurisms that I have seen, there was a very considerable dilatation of all the coats of the artery, existing along with the rupture; in some of these cases, the dilatation was so large, as almost to make one hesitate in implicitly adopting Scarpa's theory

of the formation of this disease; but the absence of the coagula of blood in those dilated arteries, sufficiently distinguish them from Aneurisms.

The late Mr Burns had in his possession a preparation, in which all the coats were dilated to a very considerable extent; but he allows, that a considerable portion of the increase was owing to the inner coats giving way at various places; and thus a real Aneurism had been formed after the dilatation of the inner coats had ceased to increase.

The tumor or aneurismal sac (which, as I have said before, is nothing else than the external cellular coat of the artery,) receives also a covering from the loose cellular sheath surrounding it; and when it happens to be situated in the cavities of the thorax or abdomen, the membranes lining those cavities form the external covering of the sac.

As the tumor enlarges, the ^{ex}ternal coat of the artery becomes more and more elevated from the muscular one ; and in course of time, the blood coagulating at different periods, causes it to put on the appearance of layers, which were formerly sometimes mistaken for the different coats of the artery.

The aneurismal sac occupies only one side of the vessel, most commonly that in which the aperture is situated ; indeed, the only case in which the contrary happens, is when the aperture in the artery is contiguous to a bone:

The tumor still further enlarging, the superincumbent parts gradually become thinner, by means of the progressive absorption ; and when the Aneurism is situated within a bony cavity, as the chest, even the bone itself is not able to withstand the effects of the pressure, but in course of time is absorbed, and the tumor at last pulsates immediately under the skin.

SYMPTOMS OF THE DISEASE.

ANEURISMS frequently appear all of a sudden ; and when they do so, they commonly give the sensation of something having given way within.

The symptoms produced by an internal Aneurism, in its incipient state, are rather obscure, and difficultly distinguishable from some other diseases ; indeed, it is scarcely possible to say with certainty that such a disease does really exist, until the tumor has arrived at such a height, as to produce an external enlargement, accompanied with an evident pulsation.

The symptoms produced by the Aneurisms of the different arteries within the cavities of the body, must vary according to their proximity to the different organs. Thus, in thoracic Aneurisms, the respiration, deglutition, and circulation, will be more affected than in Aneu-

risms which are situated in the abdominal aorta ; and in these latter cases, the functions of the intestines and organs of urine are more liable to become disordered.

When an Aneurism appears in any of the extremities, if examined particularly, a pulsation corresponding to the beats of the artery, will be evidently distinguished in it ; when pressure is applied to it, or even to the trunk of the artery above the tumor, it will disappear ; but it instantly returns, sometimes with a hissing noise, when the pressure is removed. This emptying of the sac of the Aneurism, however, can only happen in those recent cases where the blood has not coagulated.

An external Aneurism at first does not cause much pain or discolouration of the integuments. It grows larger, however, from day to day, and the pulsation becomes weaker as it increases in size. The pain becomes at length severe, accompanied with darting pains through the

limb, which also grows œdematous and benumbed; and the tumor goes on increasing till it bursts, which generally proves fatal, unless surgical aid be at hand. Generally, however, before this happens, the tumor becomes very tense, and the integuments over it grow very thin, and of a livid colour. Therefore, whenever these symptoms occur, an operation is rendered immediately necessary.

The constitutional symptoms attendant on this advanced stage of the disease, are restlessness, anxiety, loss of appetite, &c.; in short, all the symptoms arising from fever depending on irritation.

CAUSES OF ANEURISM.

It is not at all known, what induces the arterial system to take on that diseased state which renders it liable to Aneurism. This,

however, is so far known, that it is more apt to occur in people advanced in life, and, as Scarpa says, in those who have laboured long under syphilitic complaints. Scorbutus seems also to render the internal coats of arteries more liable to attacks of this disease ; as many cases of Aneurism have occurred in people who have at one period been affected with scurvy.

The situation of an artery seems some how or other to render it more liable to this disease, as Aneurisms much more frequently occur at the arch of the aorta, and in the popliteal artery, than elsewhere. By most authors, this is supposed to arise from the blood being propelled with greater force against the sides of those arteries in their curved state, conjoined (as in that of the popliteal artery) with muscular exertion ; but it is rather difficult to see how this should be the case, as there are many arteries of the body placed under similar circumstances, in which this disease seldom occurs.

When a predisposition to this disease exists, owing to the state of the coats of the arteries, any violent exertion or blow will often induce the disease ; and this will even be sufficient to produce Aneurism, where the arteries are perfectly sound.

CURE.

It is only in those Aneurisms which are situated in one or other of the extremities, that we can attempt a cure ; as, whenever this disease occurs in any of the internal arteries placed without the reach of the knife, it then becomes quite a hopeless case, and, in course of time, must almost to a certainty prove fatal.

In the cure of Aneurisms, the main object the Surgeon has in view, is the obliteration of the canal of the artery between the tumor and the heart. Nature herself sometimes effects

this, as now and then happens in those cases where the tumor presses much upon the artery, above the ruptured part ; and the same sometimes occurs in some cases where gangrene attacks the sac and deep-seated parts, the artery being shut up by the line of ulcerative inflammation, which separates the dead from the living parts ; and thus, if the patient survive the effects of the sphacelation, he gets quit of his Aneurism, though at the hazard of his life.

Many different methods have been invented, for compressing the sac itself ; but unless the pressure be so applied, as to obstruct completely the passage of the blood through the artery, by bringing its two sides into firm contact, it will be of little or no avail in curing the disease.

The pressure should be of such strength, as to induce the coats of the artery to take on the adhesive inflammation, which, by uniting the opposite sides of the vessel, converts it into a solid ligamentous substance.

Arteries, however, in some instances, will not adhere, even after the application of the ligature; which, to use Scarpa's expression, is owing "to their not being possessed of such a degree of vitality, as to be capable of feeling the stimulus, and of inflaming."

When an artery labours under that disorganization of its coats, formerly mentioned, pressure over the diseased place can be of no avail in inducing adhesion; as it has been ascertained, that the two opposite sides of such a diseased artery will never undergo a sufficient degree of the adhesive inflammation, so as to obliterate completely its canal. Since this diseased state of the vessel diminishes, in proportion to the distance from the rupture in the coats which forms the Aneurism, we can apply compression with greater chance of success, the further distant it be from the tumor.

Mr Hunter, experiencing many failures in tying the artery too near the ruptured part, was

the first who proposed that the ligature should be applied a considerable way from the Aneurism ; and his success fully answered his expectations.

Bandages and compresses of various sorts were formerly much employed in the cure of Aneurism. They sometimes did effect a radical cure ; but they as often did harm. The only case in which they can be of much use, is where the artery betwixt the heart and the tumor passes over bone, and, from this circumstance, admits of pressure being made on it, so as to cause the adhesive inflammation to obliterate the canal of the artery. But even in such cases, the requisite pressure induces very soon such a degree of swelling and pain, that the patient cannot endure it for a length of time sufficient to effect a radical cure.

The ligature possesses many advantages over the compress, and it is now generally preferred. A good deal of difference of opinion has arisen,

concerning the mode of applying it; some surgeons preferring one ligature, others two; some dividing the artery betwixt the two ligatures, others letting it remain entire. Scarpa and others recommend the use of some round substance, to be placed between the artery and ligature. And lastly, some advise the application of a second ligature, or ligature of reserve, to be placed loosely, and a little nearer the heart than the first.

When only a single ligature is applied, there is considerable danger of inducing the suppurative inflammation, instead of the adhesive, from the considerable portion of the artery that must necessarily be detached from its surrounding connections; the consequence of which will be, a sudden, and not improbably, a fatal hæmorrhage. Pieces of wood, cork, and other such substances, applied betwixt the artery and the ligature, will, on the same account, prove injurious*, as will also the loose ligature re-

* Abernethy's Essays.

commended by some surgeons ; they therefore should never be employed. When, however, two ligatures are put upon an artery, the one as high up, and the other as low down, as the incision will allow, and the vessel then divided between them, the cut extremities will recede a little, and thus will be placed as nearly as possible in the same situation as arteries are after the amputation of a limb.

Mr Abernethy *, who first proposed the application of two ligatures, left the artery undivided in the first operation he performed ; but, observing that the pain and inflammation were greatly aggravated by the tension of the undivided part, he always, after that, cut through the portion of the artery included between the ligatures, and with evident advantage.

After the artery is thus secured, the ends of each ligature should be brought out at its corresponding corner of the wound, the lips of which

* Surgical Essays.

should then be accurately brought together, and retained in that position by means of adhesive straps and proper bandages. There will be, most probably, a slight discharge from the place where the ligatures hang out; but the rest of the wound is expected to heal by the first intention. From six to eighteen days will elapse before the ligatures are detached.

The utility of the inosculating branches, in the cure of Aneurism, is now evident; for, as soon as the canal of the artery is obliterated, they begin to enlarge, and ultimately acquire a size sufficient to supply an ample portion of blood to the part of the limb beyond the Aneurism. At first, the extremity feels cold and benumbed, and no pulsation is perceptible in the trunk of the artery beyond the Aneurism; but, in the course of a short time, when these inosculating branches have increased in size, the natural heat and pulse return. This event is commonly thought to be accelerated by means of artificial heat; it is therefore generally applied to the limb in

some form or other, immediately after the operation, perhaps rolling the limb in flannel, so as to retain its natural heat, will be sufficient. It is a singular fact, that in the course of twenty-four hours after the operation, the heat of the limb, in many cases, becomes actually greater than natural, and remains so for the space of a day or two.

It may be asked, What is it that prevents the ingress of blood into the aneurismal tumor after the operation?

Very soon after the ligature is applied, the tube of the artery, for a certain length below, as well as above, the place of its application, contracts, and ultimately becomes completely obliterated. In most cases, the artery is closed, even to the place where the rupture of its coats had occurred; but in those cases in which the obliteration does not proceed so far, there is always a firm clot of blood found, shutting up the artery, from the place where the obliteration

ceases, down as far as the first anastomosing branch below the Aneurism ; which clot seems to be sufficient to resist the entrance of the blood into the tumor.

There are a few cases on record, where the pulsation continued in the aneurismal tumor for some length of time after the operation, apparently owing to some considerable inosculating branch existing betwixt the ligature and top of the tumor ; but this ceased as the artery became obliterated.

Immediately after the ligature has been applied, the aneurismal tumor becomes less, and is daily diminished in size, owing to the absorption of the coagulated blood and thickened cellular sac. The length of time the tumor takes in disappearing, varies considerably in different cases ; but in a young healthy person, after eight or twelve months have elapsed, there commonly only remains a small indolent knot.

The time when the operation becomes necessary, must be determined by the size of the tumor, the state of the patient's health, and the appearance of the superincumbent parts ; but it cannot with safety be delayed after the skin has become livid, as a speedy rupture of the tumor is then to be apprehended.

The operation becomes in some cases improper, and is contra-indicated by the following circumstances :

1. Great exhaustion of the patient's strength will in this, as in every other disease which requires surgical aid, render an operation doubtful.

2. The existence of more than one external Aneurism in the same patient, makes some surgeons hesitate to operate ; but instances are on record, in which the artery of both the limbs has been tied with success ; the operation in such a case is therefore, I think, justifiable, other circumstances being favourable.

3. The existence of an internal Aneurism along with the external one, will certainly render the propriety of an operation very doubtful ; for, besides the danger of the operation not succeeding, the patient must inevitably be, sooner or later, cut off by the internal disease ; however, the difficulty of positively determining when an incipient internal Aneurism is present, should not deter us from operating ; and unless an “ operation be obviously prohibited by the unequivocal existence of an internal Aneurism, we are, if the patient be otherwise in a favourable state, to attempt the cure of any external Aneurism by operation *.”

PALLIATIVE MEANS.

IN all cases of internal, and also in those of external Aneurism, in which the operation is

* Burns on the Diseases of the Heart.

forbid, all we can do is to avoid fatigue, and allow only a spare regimen ; to attend to the state of the bowels, and strictly forbid any thing that would accelerate the pulse. Though it is still doubtful, whether *Digitalis* possesses direct or indirect sedative properties, it is found to be serviceable in cases of Aneurism, particularly when they are situated internally.

Taking blood from the arm in small quantities, and at short intervals, has been recommended by some ; but few practitioners now employ this means, unless in those cases where great difficulty of breathing exists, arising from the size of the tumor in the thorax.

Some continental physicians have entertained a very high opinion of the efficacy of reducing the system to a very low degree, and that particularly by bleeding. M. Pelletan, who seems to be the keenest advocate in support of this practice, relates several cases in which it evidently proved serviceable, though the disease

was far advanced ; and he mentions one or two examples, which were ultimately cured by persevering in this mode of practice. Along with copious and repeated bleedings, conjoined with low diet, he used to apply pounded ice, and other cooling substances, to the tumor, which were renewed whenever they became warm ; and by a steady perseverance in these means, he observes that the tumor was in general lessened, and, in those cases which were radically cured, that it was completely absorbed in the course of a few weeks.

Opiates and antispasmodics are often absolutely necessary to relieve the symptoms which frequently attend the advanced state of internal, but more particularly of thoracic Aneurisms.

In one case of Aneurism of some of the vessels of the heart, in which the tumor appeared through the sternum, and which threatened immediate rupture, Mr A. Cooper thinks he protracted life for a day or two, by adding, daily, slips of adhesive strap over the tumor.

DIFFUSED ANEURISM.

WHEN an artery happens to be wounded, or completely cut across, by means of a fractured bone, musket bullet, or a pointed cutting instrument, and when the external wound is soon closed after the accident, the artery continues to pour out its blood, not under the cellular coat, as in the former species of Aneurism, but among the surrounding cellular substance, extending, in many cases, for a great way under the muscles, and separating these from one another, and forming generally in the space of a short time a very large irregular tumor. Tumors of this kind generally become so painful, and threaten mortification so soon, that the operation cannot long be delayed.

The operation, in this bloody tumor, differs from that for Aneurism, as the incision is generally made into the sac itself, having previous-

ly, if possible, applied the tourniquet. Great boldness and dexterity are absolutely necessary in performing this operation when the tourniquet cannot be applied, as the quantity of blood that gushes out is immense ; therefore, immediately after the sac is opened by the bistoury, the fingers must be quickly introduced into it, and the wounded part of the artery searched for ; when found, it must be instantly seized with the finger and thumb, and the hæmorrhage suppressed. The sac should then be cleaned of all the coagulated blood ; and if the artery can be seen at the bottom of the tumor, it must be tied both above and below the punctured part. If the artery cannot be easily come at, it may be separated, by means of any blunt instrument, for a little way from the surrounding cellular substance, and then it may be secured.

If the artery, from whatever cause, cannot be accurately seen, and if the hæmorrhage be profuse, the needle must be thrust under the bleeding vessel, and a portion of the surround-

ing parts inclosed in the ligature along with the artery. But this, if possible, should be avoided, as the ligature, when so applied, is very insecure, and of course, the patient is liable to suffer from secondary hæmorrhage. In this case, when the ligature is thus insecurely applied, the greatest care and attention are necessary after the operation is finished; and an experienced person is required to watch carefully over the patient.

FINIS.